Robert Schuman Centre

European Unemployment:
Macroeconomic Aspects

What Determines the Natural Rate of Unemployment? And What Does Not?

PETER WESTAWAY

RSC No. 97/43

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EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

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European Unemployment: Macroeconomic Aspects

What Determines the Natural Rate of Unemployment? And What Does Not?

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Introduction[1]

This paper examines the concept of the natural rate of unemployment (NRU) both theoretically and empirically.

There are two broad reasons why we might be interested in the NRU:

(i) The first relates to the concern we have for the steady state rate of unemployment that might pertain in some notional steady state. We are usually concerned if this number is above some socially acceptable level, and in particular if some proportion of these unemployed are involuntarily out of work.

(ii) The second relates to the level of unemployment at which inflation is supposed to stabilise. This concept is more often known as the NAIRU (non-accelerating inflation rate of unemployment), although NIIRU (non-increasing etc.) would be a more accurate acronym. The gap below actual unemployment and the NAIRU acts as an impulse for inflationary pressure.

One might expect that a paper written by someone working at a central bank might be exclusively concerned with the second concern. However, the focus of this paper is on the first aspect. Of course, in practice, these two roles are closely related not least because the long run does have the awkward habit of affecting short run behaviour.

It may be useful to start with some definitions and terminological conventions since much confusion is often needlessly generated over this issue. Consider the level of unemployment in the steady state.
It is common (if not *de rigueur*) in writing papers about the natural rate to quote Friedman's definition:

> "The (NRU) is the level which would be ground out by the Walrasian system of general equilibrium equations, provided that there is embedded in them the actual structural characteristics of labor and commodity markets, including labour market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on" (Friedman, 1968, p. 8)

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[1] An earlier version of this paper was presented at the CEPR conference on *Unemployment Dynamics* in Cambridge on December 16, 1996. I am grateful to Alan Manning, Nigel Pain and members of Structural Economic Analysis Division at the Bank of England, in particular Jumana Saleheen, Philip Evans and Nigel Jenkinson for helpful discussions on the issues discussed in this paper. The views contained herein are those of the author and do not represent those of the Bank of England.

This definition has often given rise to a semantic debate about whether a particular definition of long run unemployment (the NAIRU for example) was consistent with Friedman's definition, or whether a particular theoretical model was Walrasian. This has not always been especially enlightening. A more straightforward definition to be adopted in this paper is simply to define the NRU as the steady state level of unemployment.

If all the equations in the general equilibrium model do grind to a (dynamic) steady state, it might seem that the NRU depends on everything. In fact, for most theoretical descriptions that are used to rationalise unemployment, it does not. Instead, the NRU is found to be unaffected by the instruments of demand management and ultimately only determined by supply-side variables, or by parameters which are functions of institutional structures. This "invariance property" explains the central importance of the concept of the NRU in discussions about macropolicy.[2]

The main function of this paper is to examine the theoretical basis for this "invariance property". In order to clarify this issue, it is necessary to be rigorous about the theoretical underpinnings of the relationships between unemployment and wage-price inflation.

Two different approaches have been taken to estimating NAIRUs, structural and statistical.

- Structural methods involve the specification of relationships governing wage and price determination (or sometimes labour demand) usually based on some underlying theory of agents' behaviour. The NAIRU is then derived from these relationships by computing the dynamic steady state level of unemployment which will necessarily be consistent with stable wage and price inflation. This approach is described most fully in Layard *et al*, (1990).
- Statistical or direct methods postulate the existence of an equilibrium unemployment rate or NAIRU but make no attempt to specify the underlying behave of economic agents. Instead, the NAIRU is derived from its supposed effects based on observations of the relationship between unemployment and inflation. Elmeskov (1993), and OECD (1996) provide examples of this type of approach.

This paper is solely concerned with the structural approach. This is not to say that the more direct approach is without merit. Indeed, it has many advantages, which may explain the increasing popularity of this type of research, in particular in the

[2] It has been said that the NRU is more important for what does not explain it, rather than for what does.

US. If the focus of attention is purely on forecasting inflation, then it allows us to derive predictions of inflation from the Phillips curve; by building in hysteresis effects into the Phillips curve (by including difference terms in unemployment), straightforward cross-country comparisons can me made of the degree of inflation persistence (see OECD, (1996); simple experiments can be conducted to test whether unemployment persistence is asymmetric or whether the effect of unemployment on inflation is non-linear at low levels of inflation (see Turner, 1995); relatively simple measures of uncertainty surrounding the NAIRU estimates can be calculated (see Staiger *et al.* 1995, for example).

By contrast, this paper focuses on the structural approach to the NRU, taking a critical look at the imperfectly competitive bargaining approach popularised by Layard and Nickell. More accurately, this paper scrutinises the "textbook approach" to the battle of the mark-ups which characterises most empirical work adopting this framework (see Carlin and Soskice, 1990, for example). In doing so, two main questions are addressed.

First, is the NRU affected by movements in the labour demand curve? Many empirical estimates of the NRU are conditioned on factors which are clearly related to labour demand. Arguably, tax wedges and the real exchange rate fall into this category. This paper argues, following Manning (1993), that such effects often only arise because of theoretical inconsistencies between the price setting and wage setting equation. When the process of wage determination is specified more rigorously, it is shown that the NRU will be determined mainly by supply-side factors, although there will be a role for demand side factors to the extent that the labour share is endogenous. This issue is closely related to the question of whether the structural wage equation can be identified. In explaining how this problem arises and whether it matters, it is argued that the Manning result that the wage equation will not be identified can usually be overcome, in particular when the technology is not pure Cobb-Douglas.

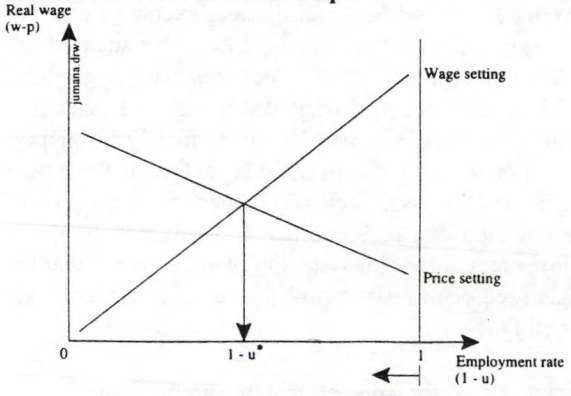
The second issue to be examined is the role of labour supply behaviour in discussion of the NRU. In the discussion of the bargaining framework, supply-side variables such as the replacement ratio are central to the determination of unemployment, yet in empirical work, these variables are often found to be insignificant or very small. The paper explains how the "size" of the replacement ratio effect depends on how exactly the wage equation has been specified. Nevertheless, it is possible that the concept of the reservation wage is actually overstated in the bargaining approach. This raises the question of whether the bargaining model is actually valid for the whole labour market. If those workers who are made unemployed by the rent-seeking activities of insider trade union members are actually competing for jobs in a secondary labour market, then

something more akin to the perfectly competitive model may be relevant. Indeed, it is precisely those workers at the bottom end of the labour market who are likely to become unemployed. But if the effective labour supply curve is actually upward-sloping or L-shaped, then the NRU will only be meaningful if the labour market is operating on the vertical portion of the labour supply curve. Illustrative empirical results are given from a stylised dual labour market model which shows that the concept of the NRU is meaningless in this type of model.

1. The textbook approach to the NRU

It is useful to begin by setting down a stylised version of the textbook approach to the NRU. This is often explained in terms of a "battle of the mark-ups", whereby unemployment must move to equilibrate the demands of employers (the feasible real wage) and the demands of employees (the bargained real wage). This can be illustrated in terms of a downward-sloping price-setting or labour demand schedule and an upward-sloping wage setting relationship which are drawn in real wage-unemployment space, intersecting to indicate the NRU.

Chart 1: The battle of the mark-ups.



Algebraically, the simple price equation is usually written as

$$p - w = a_0 + a_1 X_1 \qquad (1)$$

where p and w are the logs of the levels of prices and wages respectively and X_1 is a vector of variables such as productivity, the capital stock and the degree of product market competition which determine the mark up.

The wage-setting equation is written as

$$w - p = b_0 - b_1 u + b_2 X_2 + b_3 Z \qquad (2)$$

where X_2 is another vector of demand side variables, possibly identical to X_1, u is unemployment and Z is a vector of labour supply or wage-push factors such as union power or the replacement ratio.

For the sake of expositional clarity, no mention is made here of expectations, of wage and price dynamics giving rise to nominal inertia, or of hysteresis effects in wage setting giving rise to real inertia. All these effects are clearly crucial in determining the short run dynamics of the wage price system and its relationship between the NAIRU and the NRU. For this paper, the focus of attention is on the long run.

Accordingly, the NRU is determined by equating the expressions for real wages in equations (1) and (2) to derive an expression for the NRU ,

$$\text{i.e. } NRU = \frac{1}{b_1}\left[a_0 + b_0 + a_1 X_1 + b_2 X_2 + b_3 Z\right] \qquad (3)$$

It is immediately apparent from (3) that the invariance of the NRU to demand factors will only hold under special conditions; first, the demand factors in the price and wage equations should be the same; secondly, they should appear with an equal and opposite sign, i.e. a_1X_1=-b_2X_2. Under certain circumstances, these restrictions may appear to be justifiable, for example by including log productivity with a unit coefficient in both equations, effectively writing the system in terms of unit labour costs rather than real wages. Indeed, these restrictions are often vital in the case of trending variables such as productivity or technical progress since otherwise the NRU will tend to trend when projected into the future[3]. But in general, these demand effects will not always cancel out in the NRU expression. For example, effects from the tax wedge or real exchange rate often appear mainly due to the use of different price deflators in the wage and price equation. Joyce and Wren-Lewis (1990) for example illustrate the important implications that real exchange rate effects can have on the properties of a macroeconomic model, noting the importance of the distinction between internal

[3] In some studies, for example Minford (199x), more than one trending variable is included in the NRU expression so that the trends offset each other over the sample period (world trade and a time trend in that case). But this is clearly an unsatisfactory basis for making medium term projections for the rate of unemployment.

and external balance. But it is precisely because these effects can have important implications that we need to be sure that their presence is justified theoretically.

So despite the widespread popularity of the battle of the mark-ups model and the corresponding chart, in fact, this expositional device more often serves to confuse the issue, since moves in the price setting schedule (or equivalently in the labour demand curve) will also give rise to movements in the wage-setting schedule. This problem is caused by the presence of demand side factors in the wage setting equation. Moreover, this feature of the theoretical framework also manifests itself as a problem for econometric researchers; if all the demand side variables are included in the wage equation, then this equation will not be identified. This problem is discussed in Manning (1993) and Bean (1994) and is easily illustrated in the context of equations (1) and (2) above. Clearly, if the vector of demand side variables in the price equation X_1 is identical to those appearing in the wage setting schedule X_2, then multiples of equation (1) can be added to equation (2), thus changing the coefficients in the wage setting schedule,

i.e. $$w - p = \theta(b_0 - b_1 u + b_2 X + b_3 Z) + (1-\theta)(-a_0 - a_1 X) \qquad (4)$$

where θ is an arbitrary parameter which can take any value between 0 and 1. So (4) can be re-written as

$$w - p = [\theta b_0 - (1-\theta)a_0] - \theta b_1 u + \theta b_2 - (1-\theta)a_1 X + \theta b_3 Z \qquad (4^*)$$

Clearly (4*) has the same form as the original wage setting schedule (2), but the coefficients on X, Z and the constant will be different.

This insight does have important implications for the interpretation that can be put in the wage equation which emerges from the structural approach to estimating the NRU but on the whole empirical researchers in this area have tended to ignore the problem, usually relying on arbitrary identifying exclusion restrictions or ad hoc dynamics to identify the wage equation[4]. It is anyway important not to overexaggerate the importance of the identification problem. Even the true structural wage equation is not independent of demand factors, as already discussed, so in terms of the wage and price setting schedules of chart 1, we are simply estimating differently sloped versions of the wage curve all crossing the price curve at the same point (see chart 2).

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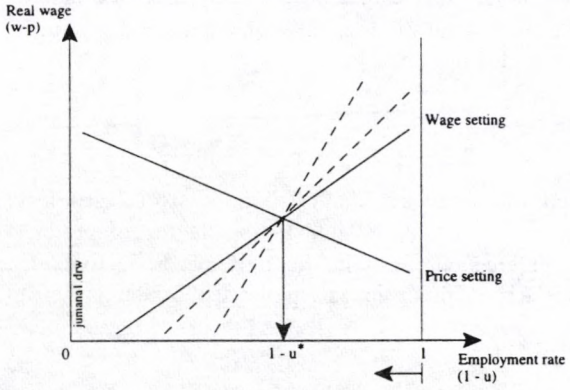
[4] See Bean (1992) for a discussion of the circumstances under which these identifying restrictions may be approximately valid.

Chart 2: The implications of lack of identification for the wage setting schedule



Putting this point slightly differently, the identification problem does not change the estimate of the NRU. Combining equation (4*) with the price equation leads to the same expression for the NRU as before. This point is frequently misunderstood; for example, Cross, 1993, and OECD, 1996 wrongly claim that the identification problem is responsible for the lack of precision in NAIRU estimates and the tendency for the NRU to change through time.

It has been suggested that one way that the identification problem can be overcome is by restricting the demand side coefficients in the wage equation to be consistent with that in the price equation (see Barrell *et al.*, 1996, for example). This is an attractive strategy since it forces the researcher to include consistent demand side variables in the wage and price equations. Unfortunately, as Manning (1993) notes, this does not resolve the problem of identification. It is easy to why by examining equation (4*) which is the general form of the unidentified wage equation. If the relationship between real wages and X is constrained to be the same as in the price equation then this can only hold for $\theta=0$, that is by replicating the price equation again.

2. A more rigorous theoretical derivation

In fact, there is a way to resolve the identification problem in most cases. In order to see how, it is necessary to be slightly more rigorous in the derivation of the wage and price equations. Let us assume that the production technology is CES,

i.e. $Y_t = [\beta(A_t N_t)^{-\rho} + (1-\beta)K_t^{-\rho}]^{(-1/\rho)}$ (5)

where Y, N and K are output, labour and capital respectively, β is the labour share and $\sigma=1/(1+\rho)$ is the elasticity of substitution between capital and labour. It is easy to show that the price equation can be written as

$$p_t - w_t = c_0 - (y-l)_t - \rho(a_t - (y-l)_t) \qquad (1a)$$

This states that the mark up of prices over unit labour costs (wages less productivity) will depend on a constant, c_0, related to the degree of product market competition, plus an endogenous term in the ratio of productivity to technical progress. This latter term will disappear in the Cobb-Douglas case (when $\rho=0$).

(1a) can be re-expressed as a term in the labour share S, where

$$s_t = c_0 + \rho[\beta + (1-\beta)(k_t - a_t - l_t)^{-\rho}]^{-(1/\rho)} \qquad (1b)$$

where the endogenous term in the ratio of productivity to technical progress has been re-expressed a function of the capital labour ratio. But if firms are maximising profits, then the capital labour ratio will be a function of relative factor prices,

i.e. $K_t/(A_t L_t) = ((1-\beta)/\beta)^{\sigma}[\frac{w_t / A_t}{c_t}]^{\sigma}$ (6)

where c_t is the cost of capital. So by substituting (6) into (1b) the endogenous component of the price mark-up can be re-written as a function of relative factor prices in the non-Cobb-Douglas CES case.
(see Rowthorn, 1996 for a related discussion of the importance of assuming the more general CES from rather than Cobb-Douglas).

Now consider the wage equation. As Bean (1994) notes, all theories of wage determination assume that the key variable is the ratio of wages to the reservation wage, usually defined as some function of unemployment benefits. This role for the ratio of inside wages relative to the outside option holds true whether we are considering models based on bargaining theories, or on a more general class of non-Walrasian model of the labour market which includes matching models and efficiency wage explanations. Perhaps surprisingly then, many empirical wage equations which purport to be based on these theories give a rather minor role to

the replacement ratio. Below, I will discuss why this may be entirely justifiable, but in the context of the theoretical models of wage determination it is not.[5]

It is useful to consider the derivation of a wage equation with rigorous theoretical underpinnings. The derivation to be followed here is fairly conventional, following closely that of Manning (1993).

It is assumed that the right to manage assumption holds, that is firms unilaterally choose employment, but bargain with employees over the appropriate level of wages. The union is assumed to maximise a utility function of the form

$$U_{it} = N_{it}^{\varphi}(V_{it} - V_t^a) \qquad (7)$$

where V_{it} is the value of employment in the firm and V^a_t is some measure of the alternatives available elsewhere in the economy. ψ represents the union's preferences for employment relative to wages. The value functions are defined as follows;

$$V_{it} = (w_{it} / P_t) + \partial E_t[q_{t+1}V_{t+1}^u + (1 - q_{t+1})V_{t+1}] \qquad (8)$$

where δ is the discount factor and q_{t+1} is the probability of a worker employed this period being unemployed next. V_t represents the value of being employed in another firm at time t, where a wage w_t is earned. V^u_t is the value of being unemployed at time t, which is given by

$$V_t^u = (B_t / P_t) + \partial E_t[s_{t+1}V_{t+1}^u + (1 - s_{t+1})V_{t+1}] \qquad (9)$$

where B_t is the level of nominal unemployment benefits and s_{t+1} is the probability of a worker who is unemployed this period remaining unemployed next. Workers made redundant are assumed to have some possibility of gaining employment elsewhere so the value of the alternative to working in the original firm is given by

$$V_t^a = \eta V_t + (1 - \eta)V_t^u \qquad (10)$$

Wages are set so as to maximise the Nash bargain where the fall back positions of both firms and unions are assumed to be zero, i.e.

$$w_{it} = \arg\max\{U_{it}^{\chi}\Pi_{it}^{(1-\chi)}\} \qquad (11)$$

[5] For example, in Bean (1994), it is hard to justify the representative wage equations given the theoretical preamble.

where χ represents the bargaining power of the trade unions. It can be shown that the first order condition for maximising the Nash maximand with respect to w_{it} is given by

$$(w_{it} / P_t) = \mu_t (V_{it} - V_t^a) \qquad (12)$$

where $\mu_t = \varphi \varepsilon_N + ((1-\chi)/\chi)\varepsilon_\Pi$

and where ε_N and ε_Π are the elasticity of employment and profits with respect to the wage.

It can be shown that in the CES case,

$$\varepsilon_N = \frac{1}{(1-\rho) - [1 - \frac{\rho}{(1-\rho)}]S}$$

and $\varepsilon_\Pi = S/(1-S)$ (where S is the labour share).

Since the labour share will be a constant in the Cobb-Douglas case, μ will therefore be a constant in the Cobb-Douglas case but will be an endogenous function of relative factor prices in the more general CES case. This distinction is crucial in what follows, in particular for the identification problem.

Once the symmetry condition is imposed by assuming that $w_{it}=w_t$, we can rewrite (12) as

$$(w_t / P_t) = \mu_t (1-\eta)(V_t - V_t^u) \qquad (13)$$

Then to derive an expression for wages in terms of observable variables, $(V_t - V^u_t)$ can be derived as

$$V_t - V_t^u = (w/P)_t - (B/P)_t + \delta E_t (s_{t+1} q_{t+1})(V_{t+1} - V_{t+1}^u) \qquad (14)$$

In order to derive an expression for the long run, it is now necessary to assume that the value functions converge to a dynamic steady state, i.e. $(V_{t+1} - V^u_{t+1}) = (1+g)(V_t - V^u_t)$ where g is the rate of growth of wages, leading to a relationship of the form

$$(W/P)_t = \frac{\mu(1-\eta)}{\mu(1-\eta) - [1 - \delta(1+g)(s-q)]} (B/P)_t \qquad (15)$$

One point to note is that Manning (1993) derives a static rather than a dynamic steady state so his empirical specification ends up with a term in the real interest rate rather than the growth adjusted real interest rate as is derived here. This has important implications for his empirical results which depend heavily on the real interest rate effect.

Finally, by making plausible assumptions about the relationship between unemployment and the transition probabilities q and s, in particular that job quitters have a probability of staying unemployed of γs (where γ<1), we can re-write (15) as

$$(W/P)_t = \frac{\mu\gamma U}{[\mu\gamma + \delta(1+g)]U - (1+\delta(1+g)q)[q\gamma + (1-q\gamma)U]}(B/P)_t \quad (16)$$

This gives as an equation for the mark-up of real wages over the reservation wage, here simply benefits, which depends negatively on the unemployment rate and positively on the wage mark-up μ.

Writing the replacement ratio, W/B as R, we can now write down a structural relationship for equilibrium unemployment,

$$U_t = \frac{\mu\gamma(1-R) + \delta(1+g) - (1+q\delta(1+g))(1-q\gamma)}{(1+q\delta(1+g))q\gamma} \quad (17)$$

This relationship illustrates clearly why, in this framework, the NRU will depend only on structural factors such as the replacement ratio and on the wage mark-up μ which as shown above will itself depend on union power and constant parameters as well as on an endogenous effect if the technology is non-Cobb Douglas CES. This expression effectively gives us the vertical quasi-labour supply curve in the bargaining framework. In terms of the earlier diagram showing the wage and price setting curves, this defines the locus of equilibrium points which is traced out as labour demand is shocked (and hence as both the wage and price setting schedules are moved)

So what are the implications of this theoretical derivation for empirical researchers, many of whom have claimed to be basing their empirical approach on the bargaining framework? Equation (16) appears to give a clear recommendation. If the bargaining framework is valid, then real benefits should appear in a wage equation with a unit coefficient. But this would appear to contrast starkly with modelling practice. Often, equation (16) is log linearised, extra demand side variables such as productivity are added and the replacement ratio effects often have small and insignificant coefficients. Usually, the effect

from the replacement ratio is dropped altogether. but this can not be valid under the maintained theoretical model since the replacement ratio is the theoretical linchpin of the bargaining approach.

Manning (1993) shows how this apparent contradiction can be resolved. Returning to equation (17), we have already shown how the wage mark-up μ can be written as $\mu=\mu(S,\chi)$ where S is the labour share and χ is a proxy variable for bargaining power. Log linearising (17) and rearranging so that the labour share is on the left hand side, we have an expression

$$s=\theta_0-\theta_1 U_t+\theta_2 R_t+\theta_3\chi \qquad (18)$$

and substituting in for the determinants of the labour share,

i.e. $s=w+n-p-y$,

we can write an expression for wages as

$$w_t-p_t=y_t-n_t+\theta_0-\theta_1 U_t+\theta_2 R_t+\theta_3\chi \qquad (19)$$

This now looks much more familiar. Note that the replacement ratio still appears but no longer with a unit coefficient. (19) is the equation which Manning notes is unidentified because all of the variables from the labour demand curve (or from the price setting equation) are included in it. If Cobb-Douglas technology is assumed, this is clearly correct. If the Cobb-Douglas price setting equation implies a constant mark-up (say c_0 in the log equation), then any attempt to estimate the structural equation (19) will in fact deliver

$$w_t-p_t=y_t-n_t+\lambda c_o+(1-\lambda)(\theta_0-\theta_1 U_t+\theta_2 R_t+\theta_3\chi) \qquad (20)$$

where λ is an arbitrary parameter (depending on the covariance properties of the two structural equations).

Importantly, however, this equation will be identified in the general CES non-Cobb-Douglas case since the labour share then also depends on relative factor prices. If such a term were to be included as suggested by Manning in order to capture the CES case (p.107, Manning, 1993), then identification would fail. but there is no reason to include such a term since it is the labour share itself which should appear in the structural wage equation.

3. Empirical results

I now illustrate how such a wage equation can be estimated by including the labour share in a cointegrating relationship based on the structural unemployment relationship as derived in equation (17). Details of the econometric specification are as follows;

- The UK unemployment measure used here is the proportion not working of the total population of working age. This measure is preferred to the official claimant count which does not give as accurate a picture of true excess labour supply due to periodic shifts in the number of people moving off unemployment register to claim sickness and disability benefit. Ideally, a search-based ILO measure of unemployment would be used but this is not constructed on a consistent back to the 1960s as we require. Chart 3 illustrates.
- The data for the replacement ratio used in this paper is based on data provided by the Department of Social Security and analysed further by HM Treasury. In the context of this paper, it is important to emphasise one main point which stands out from the most cursory analysis; most measures of the replacement ratio, whether based on a naive expenditure basis (i.e. based on aggregate unemployment benefits paid out) or on a more sophisticated analysis based on the circumstances of different family types, all tend to trend downwards while any explanation of increased unemployment since the 1960s requires it to trend upwards. One possible explanation for the failure of the falling replacement ratio to track unemployment rates is that the denominator overstates the relevant earnings measure for an unemployed person. This will be a serious problem at a time when the earnings dispersion is widening. This measure of the replacement ratio has been modified by using the average earnings of manual workers in the denominator but this may still underestimate the true replacement ratio, especially if the "entry wages" for those trying to re-enter the labour market are particularly low. For the numerator, the weighted benefit payment paid to different categories of the unemployed has been used. Chart 4 illustrates. Clearly, the trend is still downwards.
- Chart 5 illustrates the labour share taking into account the effect of employers taxes. This shows a clear downward trend over the estimation period. Given the theoretical arguments advanced in the last section, this should cause unemployment to rise.
- In order to pick up unemployment persistence effects arising from hysteresis, a term in the proportion of long term (more than 12 months) unemployed is included. Chart 6 illustrates.
- A term in the growth adjusted (backward-looking) real interest rate is included. See chart 7.

shows the results from the Johansen estimation procedure. Cointegration is seen to fail when the labour share is excluded but one vector is present at the 95% confidence limit when it is included. Normalising on unemployment, all variables take their expected sign , with positive and significant effects from the replacement ratio, long run unemployment, with a negative effect from the labour share. No role was found for the growth adjusted interest rate.

Chart 3: Percentage of the population not working

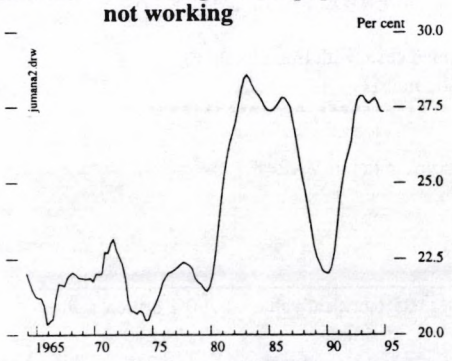


Chart 4: Replacement ratio

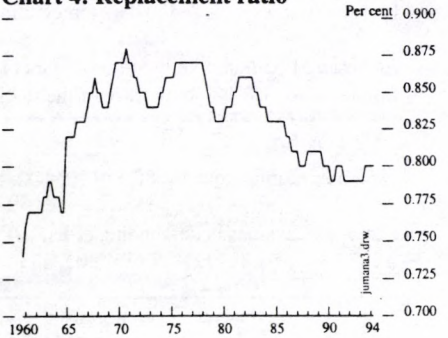


Chart 5: Labour share

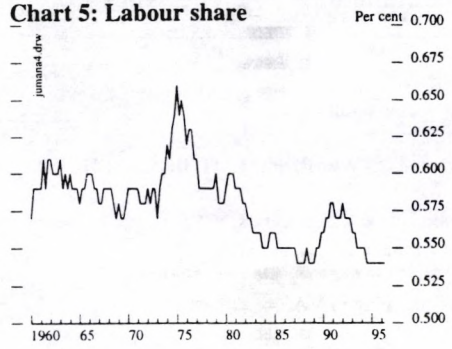


Chart 6: Long term unemployment rate

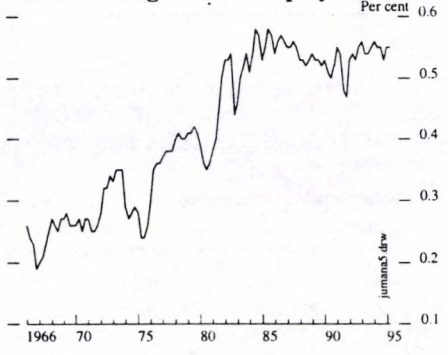


Table 1: Long run estimation results

(I) Labour share not included: Cointegration rejected

List of variables included in the cointegrating vector: PNWR, REPR, LMTUR

Johansen Maximum likelihood procedure (Trended case, with trend in DGP)
Cointegration LR based on trace of the stochastic matrix.
****

106 observations from 1968Q1 to 1994Q2. Maximum lag in VAR=8.

List of eigenvalues in descending order:
.12077 .091991 .012483

Null	Alternative	Statistic	95% critical value	90% critical value
r=0	r>=1	**25.2037**	**29.6800**	26.7850
r<=1	r>=2	11.5607	15.4100	13.3250
r<=2	r>=3	1.3316	3.7620	2.6870

(II) Labour share included: Single cointegrating vector significant:

List of variables included in the cointegrating vector: PNWR, REPR, LMTUR, LABSH

Johansen Maximum likelihood procedure (Trended case, with trend in DGP)
Cointegration LR based on trace of the stochastic matrix.
****
106 observations from 1968Q1 to 1994Q2. Maximum lag in VAR=8.
List of eigenvalues in descending order:
.21121 .12006 .072402 .018156

Null	Alternative	Statistic	95% critical value	90% critical value
r=0	r>=1	**48.6153**	**47.2100**	43.949
r<=1	r>=2	23.4663	29.6800	26.785
r<=2	r>=3	9.9089	15.4100	13.3250
r<=3	r>=4	1.9422	3.7620	2.6870

Estimated normalised cointegraing vector:

PNWR=0.600 REPR + 0.181 LMTUR-0.692 LABSH
Data definitions:
PNWR: Percentage of working population not working
REPR: Replacement ratio defined using earnings of manual workers
LMTUR: Share of long term (>26 weeks) unemployed in total unemployment.
LABSH: Share of wage bill in money GDP.

4. But what if the bargaining model is not valid?

The last section has showed that the practical problems in deriving structural estimates from the NAIRU caused by the identification problem may not be as severe as has been suggested. But arguably, there is one much more severe problem with the bargaining framework. This relates to the sector who are not covered by bargaining arrangements. Typically, this is dismissed as a minor irritation, despite the fact that trade union coverage has fallen substantially in the UK in recent years. It is often argued for example that other non-Walrasian theories of wage determination may still apply. Two main classes of models are usually suggested;

Search theories;

The simplest search-theoretic models explain 'frictional' unemployment as the inevitable consequence of a dynamic labour market where jobs are being created and destroyed and workers take time to find new employment. More sophisticated versions of this theory focus explicitly on heterogeneities and mismatches which make it costly for a worker and a firm to match their requirements, for example because of search costs for employees or hiring and training costs for employers (see Pissarides, 1990, for example). This transaction cost introduces local monopoly "rents" so that apart from compensating workers for the value of their marginal product as in the perfectly competitive case, firms and workers generate an additional surplus to be shared that is not driven to zero by competitive forces. This pushes unemployment above the market clearing NRU. Of course, the heterogeneity arises in the search model because insiders and outsiders differ (once hired, an employee is cheaper than an outsider). This distinction is clearly very closely related to the insider-outsider issue in bargaining models.

Efficiency wage models;

In these models, firms do not allow wages to fall to competitive levels since a higher wage is assumed to extract more input from the labour force, for example because higher wages attract higher quality workers or because they discourage shirking (for this reason, these are also referred to as "incentive wages"). Whereas unemployment served to discipline wage demands in the bargaining models, unemployment now acts as an incentive to spur higher productivity. As with the other models, a premium is earned, this time related to the difficulties in measuring individual workers' characteristics, which pushes wages above reservation levels and hence unemployment above the market-clearing NRU.

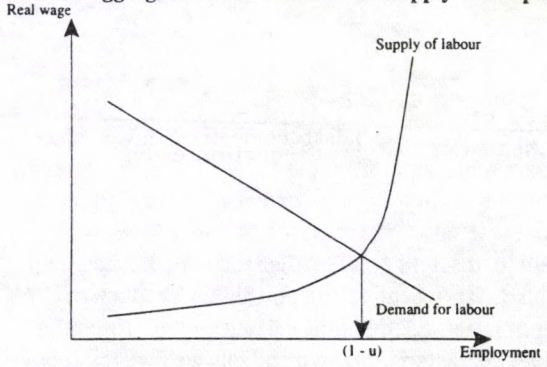
Given these theories, very similar structural variables are cited to explain changes in the steady state level of unemployment, in particular; the replacement ratio, since this represents the outside option to employees in all the theoretical models).[6]

But it is also important to acknowledge, as is done explicitly in the dual labour market models proposed by Minford, (1983) for example, that the labour market may be much closer to the perfectly competitive paradigm for some sections of the labour market. This is very important since it will be in this "residual" labour market where aggregate unemployment will ultimately be determined. Consequently, it is useful to consider slightly more carefully what the implications of the market-clearing model is for the NRU paradigm.

The market-clearing model of the labour market

For simplicity, let us assume that labour participation is an all or nothing decision (arguably this is the relevant issue for the unemployed, not variation in hours), individual labour supply curves will be L-shaped. Individuals will accept any job above a wage-floor or reservation wage. This will be determined by the benefits received while unemployed (but not received while working). The critical reservation wage may be higher or lower than benefit levels depending on whether or not work incurs negative or positive utility. An aggregate labour supply schedule can be traced out by aggregating across individuals. The resulting curve illustrated in chart 8 will be convex to the origin due to heterogeneity in preferences (the more alike are individuals, the more L-shaped it becomes).

Chart 8: Aggregate labour demand and supply under perfect competition



[6] Ideally, this factor should be defined in present value terms to capture the important effects of benefit duration

The key feature of this model is that all unemployment is "voluntary". If it were otherwise, unemployed workers could offer themselves at lower wages, driving pay down to the reservation wage. Thus, unemployment is entirely explained by the marginal replacement ratio; equilibrium employment is determined by the point where the marginal revenue product of workers equals the reservation wage.

From the perspective of the NRU, it is also worth noting, although it is seldom emphasised, that there is no necessary reason why the equilibrium should be on the vertical portion of the aggregate labour supply curve. In such circumstances, shocks to labour demand will have permanent effects on unemployment and the concept of the NRU will not be very helpful for policy purposes.[7] From the perspective of conventional NRU analysis this may seem heretical but there is increasing evidence that labour supply elasticities with respect to wages relative to outside options are very high amongst unemployed unskilled workers. Evidence to suggest that employment in these types of labour market in the US are driven by demand shocks is presented by Juhn *et al.*, (1991) .

It is useful to illustrate this point, albeit in a stylised way, by modifying the labour market equations of a conventional macroeconomic model. Let us suppose that the labour market consists of two types of labour, skilled and unskilled. The former are assumed to set wages in a bargaining framework while the latter participate in perfectly competitive markets. The number of potential workers in each category of labour is fixed, for simplicity at half the total working population. Demand for the different types of labour is conditioned on total labour demand which is based on conventional labour demand curves consistent with CES production technology (see NIESR, 1995). Relative demand for different types of labour is affected by relative wages with an elasticity of 0.2. This estimate is based on a crude calibration exercise. Wages in the market for skilled labour are set such that, in the long run $(1-\alpha)$ per cent of the skilled workforce find jobs. α is set at 2 per cent to represent the effects of insider-outsider forces or efficiency wages. The dynamics for this skilled wages equation are identical to the aggregate equation estimated before. All unemployed skilled workers overflow into the market for unskilled workers where they are treated as if they were unskilled. Wages in the unskilled sector are determined by the interaction of the labour demand schedule with an upward sloping labour supply schedule of the "textbook" form shown in chart 8. Importantly, this has a horizontal portion and a vertical portion. It is clearly an empirical question as to which is the most appropriate functional form; this issue is not addressed here.

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[7] Importantly, this is not the same as saying that there is an inflation-unemployment trade-off.

Now consider a permanent increase in government spending. Charts 9(a)-(d) compare the effects of assuming that unskilled workers are operating on the vertical portion of their labour supply curve compared with the effects of the same shock when the horizontal part of the unskilled labour supply function is assumed to be operational. In the former case, the vertical labour supply curve ensures that unemployment and GDP returns to base in the long run. By contrast, in the latter case, if it is assumed that unemployment benefits are marked up in line with the earnings of unskilled workers, then because the increase in demand does not push up the wages of unskilled workers, unemployment falls (despite the fact that the replacement ratio is unchanged). The initial increase in the demand for workers in general is translated into a long run increase in the demand for unskilled workers only as the wages of skilled workers rise, both in absolute terms, and also relative to unskilled workers, who therefore become relatively more attractive to employ.

This example of the horizontal labour supply curve has deliberately been chosen to emphasise the effect of differences in labour supply behaviour between skill groups. In general, the size of the increase in demand for unskilled workers will depend on the shape of the labour supply curve and the position of the unskilled workforce on it.

Charts 10(a)-(b) show the effects of the same shock, now operating on the sloped portion of the labour supply curve. For simplicity, the elasticity of labour supply with respect to the replacement ratio is assumed to be 0.5. Two different sets of assumptions are examined, first that nominal benefits are fixed in nominal terms, then that benefits grow in line with average earnings. In the former case, because the shock raises nominal wages, the replacement ratio falls and unemployment falls in the long run accordingly (this may be thought of as cutting the benefit rate by stealth!). In the latter case, the movement in unskilled earnings is broadly similar to that of total earnings since the uprating of unemployment benefits in line with earnings has the effect of raising the labour supply curve by just enough to leave the ex post replacement ratio and hence unemployment virtually unchanged in the long run.[8]

The purpose of these simulation results has been to illustrate how changing the basic assumptions about how the labour market works, actually in a rather plausible way, can have fundamental implications for the model properties and for the concept of the NRU in particular.

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[8] A similar exercise on a calibrated model is carried out in Pissarides (1996) who shows how the effect of a change in employers' payroll taxes is crucially influenced by the assumption that is made about how unemployment benefits are uprated.

Chart 9(a): Government spending shock
Unemployment rate (% of economically active)

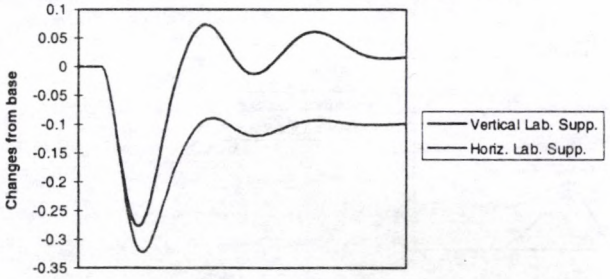


Chart 9(b): Government spending shock
Real GDP

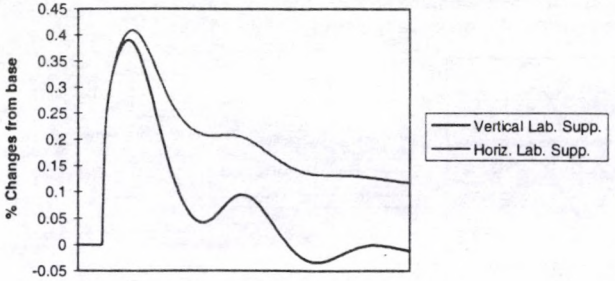


Chart 9(c): Government spending shock
Number of unskilled workers in employment

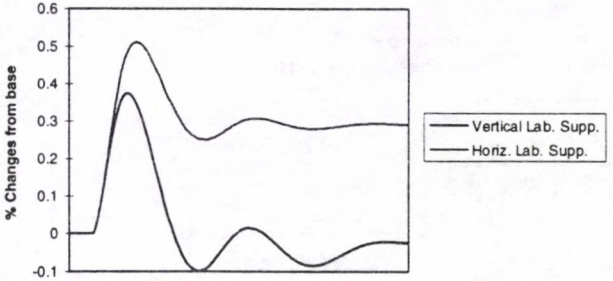


Chart 9(d): Government spending shock
Number of skilled workers in employment

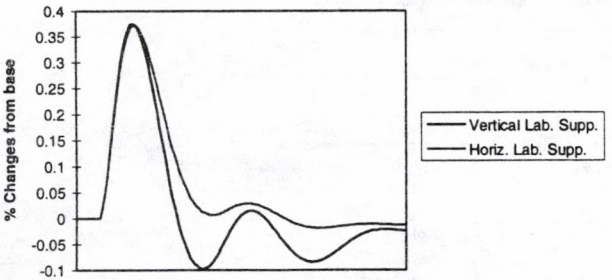


Chart 10(a): Government spending shock;
Unemployment rate (% of economically active)

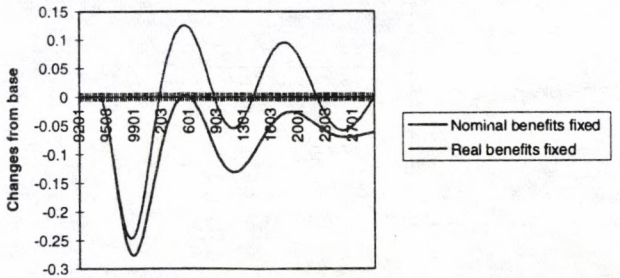
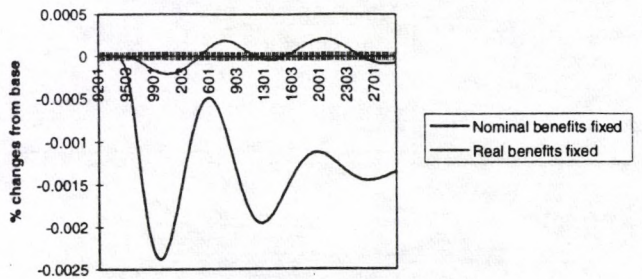


Chart 10(b): Government spending shock;
Replacement ratio (defined using unskilled earnings)



5. Conclusions

The NRU has assumed an important role in macroeconomic policy thinking because it places a limit on what macroeconomic policy should ultimately be expected to achieve in bringing down unemployment. If the steady state rate of unemployment actually can be affected by demand-side variables, then the conventional wisdom which focuses completely on structural supply-side reforms of the labour market to cut unemployment may be misplaced.

Surprisingly many empirically estimated NRUs do include demand side variables of one sort or another; the real exchange rate, world trade, the oil price, tax wedges. Indeed some of these demand side effects would seem to be implausible, sometimes implying a NRU that trends into the indefinite future. Taking the conventional framework of the imperfectly competitive bargaining model, this paper has argued, following Manning (1993) in particular, that many of these effects emerge because of insufficiently rigorous theoretical underpinnings to the wage determination process. The extent to which the NRU can nevertheless be affected by the demand side through relative factor prices is explained and it is shown how this feature can be exploited to resolve the well known identification problem afflicting structural wage equations. An empirical estimate of the UK NRU has been derived using this approach.

Of course, it must be acknowledged that the distinction between absent demand effects on the NRU and highly persistent effects due to hysteresis mechanisms only resolves itself in the very long run. Various different sources of hysteresis have been discussed in the literature. Here, an alternative explanation is offered as to why the NRU tends to move around so much, especially in the face of demand shocks. This is because significant parts of the labour market may be competitive, in particular for those workers most prone to becoming unemployed, and workers may not be operating on the vertical portion of the labour supply curve. Indeed, if they were, the effect of cutting benefits would have little effect on unemployment (see chart 8 again). This paper has produced no empirical evidence to support this argument. But if it is true, it is all the more important that a structural rather than a purely statistical approach to analysing the labour market is taken which recognises the important heterogeneities in the labour market. The challenge for empirical modellers of labour market behaviour is to determine the extent to which the inevitably inadequate information about the demand and supply for different types of labour can be used to uncover the aggregate implications for unemployment.

February 1997.

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